



# Estimating Transaction Costs of REDD +

Mary Nantongo\*, Arild Vatn

Department of International Environment and Development Studies, Norwegian University of Life Sciences, Universitetsstuen 3, 1433 Ås, Norway

## ARTICLE INFO

### Keywords:

Transaction costs  
REDD + policy  
Governance structures  
Brazil  
Tanzania

## ABSTRACT

Reducing emissions from deforestation and forest degradation (REDD+) is generally believed to be a cost-effective mitigation strategy against climate change. Some suggest, however, that costs of REDD+ are underestimated because many studies either exclude or undervalue transaction costs. A major challenge in this field of research is the absence of a common framework and methodology for assessing such costs. This paper uses the notion of governance structures to suggest a generic definition and methodology for measuring transaction costs. The methodology is subsequently used in an analysis of transaction costs for REDD+ pilots in RDS Rio Negro, Brazil and Kilosa, Tanzania. Results indicate higher unit costs – costs per ton of reduced CO<sub>2</sub> – of establishing the REDD+ governance structures in Kilosa, while unit costs of using those structures are higher in RDS Rio Negro. The results also show that while REDD+ was originally conceived as a market i.e., a direct trade between buyers and sellers, it could also take on a non-market governance structure or a mixture of market and non-market elements. These different forms of governance structures have implications for transaction costs.

## 1. Introduction

There is widespread support among economists for the idea that reducing emissions from deforestation and forest degradation (REDD+) is a cheap mitigation strategy when compared to other options (e.g., Stern, 2007). Yet, while cost-effectiveness or efficiency is at the heart of REDD+ policy, there is concern that cost studies rarely give a complete coverage of all costs<sup>1</sup> involved, because most either exclude or underestimate transaction costs (Fosci, 2013; Pearson et al., 2013; Rakatama et al., 2017).

In empirical work, the concept of transaction costs has been widely applied to public policies (Wang, 2003). With specific reference to environmental policy, transaction costs are believed to be relevant for the design and selection of policies (Paavola, 2002; McCann, 2013). Even then, economists still grapple with the basic conceptual aspects of transaction costs, particularly what they are and how they should be measured (Wang, 2003). Since there is considerable variation in the methods and definition of concepts used in empirical analyses, it is difficult to compare across studies (Dawkins, 2000; Antinori and Sathaye, 2007), which complicates the task for policy makers to select between competing policies.

In this paper, we suggest that a possible reason for the ambiguity in transaction cost measurement is that transactions are so diverse and

operate in a wide variety of circumstances. The aim of the paper is therefore to suggest a definition of transaction costs that can be used across different contexts. Based on that, we present a methodology for measuring these costs and exemplify it using data from two REDD+ pilots in Brazil and Tanzania. Our focus is on transaction costs for REDD+ at the local level, but the methodology developed should also be relevant for analyses at other levels as well as fields of study outside REDD+.

## 2. Defining Transaction Costs

### 2.1. A Complex Field of Definitions and Perspectives

Conceptualization of transaction-cost traces back to Coase who argued – in sharp contrast to conventional environmental economics at the time – that carrying out market transactions carries costs (Coase, 1937). Commenting on Pigou (1920), Coase further argued that if market transactions were costless, assigning private property rights was enough to trigger private trades, through which victims of pollution would price out the polluters and ultimately lead to the elimination of environmental problems. However, because market transactions do in fact entail costs, resource allocations may sometimes need to be resolved through means other than markets including government

\* Corresponding author.

E-mail addresses: [mary.nantongo@nmbu.no](mailto:mary.nantongo@nmbu.no) (M. Nantongo), [arild.vatn@nmbu.no](mailto:arild.vatn@nmbu.no) (A. Vatn).

<sup>1</sup> The costs for REDD+ can be divided in three categories. They include opportunity costs – the value foregone from alternative land use – production costs – costs of activities that directly lead to increase in forest carbon storage like gap filling and nursery establishment – and transaction costs.

regulations, taxes, subsidies, standards (Coase, 1960; Dahlman, 1979).

Although Coase's contributions have been greatly influential across a variety of economic disciplines, they have also been a source of tremendous controversy and diversity in interpretation (Allen, 1999; Wang, 2003). At the root of the problem are the two dominant schools – the neoclassical and the new institutional economics positions. The standard neoclassical model assumes zero transaction costs and private property rights for all goods. Further, property rights are always completely defined, allocated and enforced (De Alessi, 1983). Hence, neoclassical scholars have typically omitted transaction costs from analyses. Yet, there is currently wide acceptance also among neoclassicals that trading carries costs, and as a result a recognition that property rights may sometimes be incomplete. Increasingly, therefore, analyses do treat the subject of transaction costs (and their links with property rights). When included, however, this tradition deals with the two concepts only in the context of trade. Thus, transaction costs would typically be defined as costs that occur in the transfer of property rights between firms or individuals through market exchange (e.g. Demsetz, 1964; Niehans, 1987). Further, cost categorization is based on activities aimed at overcoming imperfect information and uncertainty in market exchanges. Examples include search, approval, negotiation/bargaining, decision-making, insurance, monitoring and enforcement costs (Stavins, 1995; Dudek and Wiener, 1996). Therefore, only costs which are external to market participants are relevant. Internal costs such as administrative or enforcement costs within firms are not considered (Allen, 1999).

The approach of new institutional economics expands beyond focusing only on trade to include also costs of command within hierarchies like firms, public entities, and households (Pollak, 1985; Williamson, 2000). When analyzing the costs of market exchange, for example, studies consider both participants' external costs of overcoming imperfect information and internal costs of organizing trade (as long as they are not costs of production) as transaction costs (e.g., Wallis and North, 1986). A typical definition in the new institutional tradition would be the costs of defining and maintaining property rights (Allen, 1999; McCann et al., 2005). According to this literature, all aspects of allocating property rights are costly. Markets may not always be the option with least transaction costs. Therefore, the goal of analysis is to decide which governance structure should be chosen based on the criteria of economizing most on transaction costs – i.e., efficiency (Williamson, 1981; Dawkins, 2000).

The new institutional school has found a considerable audience among scholars of society and economics. This is understandable because by widening the scope of transaction cost analysis and including broader forms of property rights and other institutions (North, 1992), new institutional economics circumvents some shortcomings of the neoclassical paradigm. Nevertheless, it maintains core aspects of this approach (Eggertsson, 1990), particularly the rational choice model (Gottbauer and van den Bergh, 2011). Within this individualist-utilitarian ideology, policy prescriptions always gravitate towards welfare-based solutions – minimizing cost and maximizing benefits.

For those of us concerned with transaction costs, this is problematic, not least in the context of environmental policy. One issue regards the extent to which one could rely on efficiency as the only criterion for the selection and design of policies (Dawkins, 2000), when it is increasingly understood that equity, effectiveness and legitimacy may be equally important (Colby, 2000; Buitelaar, 2004; Vega and Keenan, 2014). A related concern is that institutional economists have conceptualized determinants of transaction costs (asset specificity, frequency, and uncertainty) within a market context (Williamson, 1985). We observe, however, that analysts have had to adjust this framework in order to cater to the unique aspects of environmental goods and to explain better what influences transaction costs in arrangements that deviate from 'pure' markets (Ruiter, 2005; Antinori and Sathaye, 2007; Rørstad et al., 2007; Coggan et al., 2010; Coggan et al., 2013; McCann, 2013; Phan et al., 2017).

So, due to the 'rather uneasy' extension from neoclassical to new institutional economics, there is considerable ambiguity and inconsistency regarding the transaction cost concept, which has made it extremely difficult to compare results, as different studies include or exclude different types of costs as well as include or exclude different types of transactions. Perhaps an all-encompassing framework would help resolve the issue.

## 2.2. Transaction Costs as Costs of Establishing and Using Governance Structures

From the above, we observe that the definition of transaction costs varies because of different system delimitations – i.e. what kind of human interactions that are included. Progress towards a shared definition demands a common platform with a delimitation of transaction costs that captures all types of transactions that are relevant for economic activities. We find that the conceptual framework of a governance structure serves such a purpose. A governance structure (GS) may be defined as consisting of:

- a) the actors involved – e.g., individuals, communities, public bodies/agencies, firms, non-governmental organizations (NGOs) or inter-governmental organizations (IGOs) – with different forms of rights and responsibilities.
- b) the institutions defining the rights and responsibilities of these actors and facilitating the interactions between them (Vatn, 2015).

Actors may interact in different ways. We have already noted trade and command. Actors may however also donate, cooperate or reciprocate. Taken together, there may be numerous governance structures – hence, forms of transactions (Vatn, 2010, 2014). When there is direct interaction between producers and buyers in the form of trade, the resulting governance structure is the simplest form of a market – see GS1 in Fig. 1. However, producers and buyers often do not interact directly. We observe intermediaries such as wholesalers and brokers. In this case, the resulting governance structure would often be a series of trades – see GS2c. However, also public bodies and NGOs could act as intermediaries. Then we may face a mix of market and non-market elements as in GS2a, or purely non-market transactions as in GS2b.

The actors involved are defined by their rights and responsibilities. Rights to resources – property or use rights – are important aspects. Various responsibilities are typically also defined and exist as characteristics of actors. Some of these structures are formal while others are informal. Both kinds are important when characterizing actors.

While the above emphasizes economic interactions, governance also regards political interactions – i.e., the transactions, which define rights and responsibilities in the economic sphere. They cover public monitoring, enforcement, and litigation. They also cover contracting of government services to private actors or civil society actors (Moe, 1990). They finally regard establishment of political actors, electing leaders/political bodies and the interactions between different levels of public leadership – e.g., the state, district, municipal, village council, clan leaders etc. (Vatn 2015). There are also transactions among civil society and between civil society and political actors regarding dissemination of information, political debate, advocacy or mediation.

## 2.3. Operationalization of the Framework

Based on the above, and in agreement with Marshall (2013), we define transaction costs as the costs of establishing, maintaining, changing and using a certain governance structure.

We thus propose a framework that distinguishes between two broad cost categories: 1) costs of developing and 2) costs of using a governance structure. The first category encompasses establishment, maintenance and change costs of actors and institutions comprising the governance structure. These costs arise out of activities such as

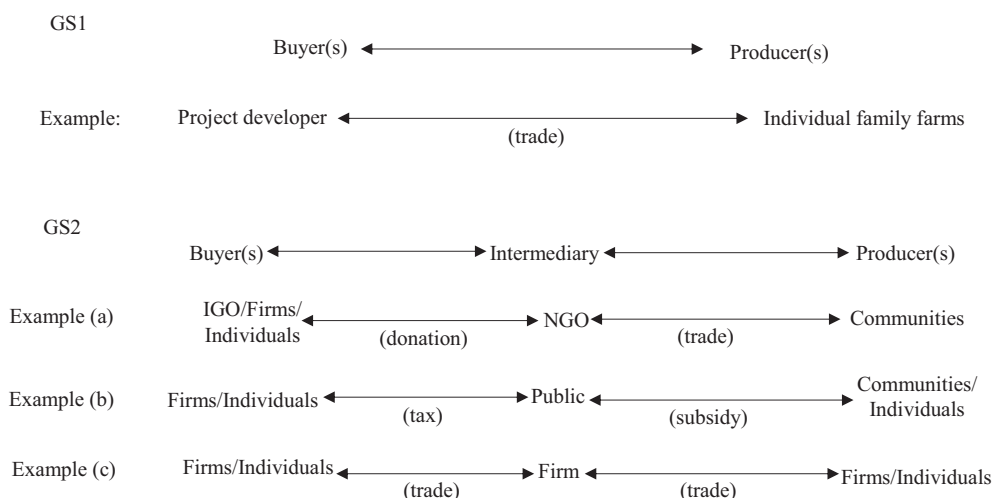


Fig. 1. Examples of governance structures.

obtaining information about the problem, defining the problem, seeking consensus about how to respond, instituting the necessary legislation and developing organizations to tackle the issue. The costs of using a governance structure on the other hand, relate to making and implementing plans and decisions based on the governance structure created. These costs could therefore be generated by activities inherent in market transactions (e.g., searching for trade partners, negotiating deals and transferring resources or property rights) or could be of a more public (e.g., costs of monitoring and enforcing compliance and conflict resolution) or civil society nature (e.g., costs of cooperation, reciprocity and advocacy) in non-market or mixed-market governance structures. Then, there are costs that are important for both the development and use of a governance structure including costs of administration as well as planning and decision-making. It may be demanding to split these on the other activities specified and we refer to these as general support. Table 1 offers an attempt to summarize these cost categories. Irrelevant combinations/cells are marked grey.

The approach pursued here is similar to proposals by Buitelaar (2004), who distinguishes between transaction costs of creation and use of institutions and Hanna (1995) who distinguishes between costs of describing the resource context, designing, implementation and enforcement of a particular program. However, by distinguishing between costs of establishment and costs of maintenance and changes, (see also Paavola, 2007), the framework explicitly highlights the fact that policies are never implemented in a vacuum. There will always be an existing governance structure. While it will not be logical to include the costs of establishing these when calculating the costs of introducing a specific policy, describing well the governance structures into which it is placed is important. Costs of establishing a certain governance structure depends not least on what 'is already there'. As an example, costs will vary dependent on whether property rights are already clarified or not. Also, the existing governance structure is likely to have cost implications for establishing new ones as has been demonstrated by Marshall (2013) discussing the effect of path dependency.

More importantly, however, this framework has a major strength in that it generalizes across costs generated and incurred by a broader range of actors and institutions. As such, it avoids a priori exclusion of costs accruing to certain types of actors and interactions. Previously, most frameworks have been specifically targeted to a particular context and subject of investigation (see also Galik et al., 2012). Thompson (1999) and McCann and Easter (2000) have for example been concerned with public costs of environmental policy, Stavins (1995), Dudek and Wiener (1996), and Antinori and Sathaye (2007) with private costs, while Abdullah et al. (1998) investigated transaction costs in the case of a fisheries co-management system. While there have also

been attempts to account for both market and non-market elements (e.g., McCann et al., 2005 and Milne, 1999), overall the current frameworks are largely dependent on a research context, which limits their analytical usefulness in other types of governance arrangements. Therefore, a framework that is generic enough to capturing variation and complexity is more likely to encompass broader forms of interactions. This is particularly important as environmental governance, in recent decades, has progressed from being majorly state-led – with top-down processes – to becoming more participatory – involving also market actors and civil society at different spatial scales (Bäckstrand, 2006; Lemos and Agrawal, 2006; Paavola, 2016).

Distributing costs on various actors may therefore also be of interest (see also McCann et al., 2005). This is important both regarding distributional effects and to make coherent efficiency analyses. We often encounter that costs of planning and establishing new institutions are covered by public authorities, while efficiency analyses do not include these costs. Finally, it is important to be clear about the level at which one wants to focus. While establishing a policy at the local level may demand institutional change at higher administrative levels, it is still meaningful to look at costs at the local level only. It is, however, important to clarify which changes at higher levels have been necessary to make the policy at the local level work in a meaningful way – i.e., which costs are relevant, but not included in the specific analysis.

In summary, we have suggested to operationalize the framework of analyzing transaction costs by using the notion of governance structures. We have recommended breaking down the costs into two broad generic categories of *developing* (establishing, maintaining and changing) and *using* governance structures. Within these two broad classes of costs, there could be further categorizations based on, for example, the tasks performed (e.g., obtaining information and developing actors and

**Table 1**  
A generic structure of transaction costs categories.

Cost category	Developing the governance structure			Using the governance structure
	Establishing	Maintaining	Changing	
1. New institutions				
2. New actors				
3. Existing institutions				
4. Existing actors				
5. Operations by actors				
6. General support				

Note: Shaded areas are not relevant categories.

institutions), the actor that bears the cost (e.g., communities, NGOs or public bodies), the level at which costs occur (i.e., local, national or international), and budget categories (such as personnel, consumables and travel).

## 2.4. Transaction Costs in the Context of REDD+

The core idea of REDD+ was to design an economic transaction – a performance-based system where local communities were meant to deliver carbon storage against a payment. While some seem to have thought of carbon as an already defined commodity, it soon became clear that creating a tradable entity was a complex process of mobilizing communities and defining rights. Included in that were issues related to protecting the integrity of local communities including the decision whether local communities want to participate – often referred to as ‘free, prior and informed consent (FPIC)’ – and designing of benefit sharing systems. Putting plans/decisions into practice also implied the establishment of new actors like national REDD+ agencies and committees at village level or making adaptations to existing ones. Institutional changes were also necessary – e.g., defining property rights and new management practices for forest resources – e.g., maps, bylaws and signposts. Added to these concerns, issues related to developmental and distributional effects of REDD+ became important. Finally, biodiversity protection also became a key issue (Angelsen et al., 2009). Given this multiplicity of interests and hence actors, REDD+ exhibits economic, political and civil society aspects of transactions albeit at varying degrees depending on the context in which it operates.

REDD+ therefore implies a kind of institutional change that shows the importance of thinking in terms of governance structures as defined above. Decisions affecting use of environmental resources – and hence carbon sequestration – are influenced not only by prices and formal institutions, but also informal institutions such as norms and conventions (Ostrom, 1990; Jones et al., 2008). Equity issues are key (Stern, 2008; Di Gregorio et al., 2013). Moreover, collective action is at the heart of most REDD+ arrangements as forest resources in most developing countries are appropriated communally or in collaboration between local people and the governments (Berkes, 2007). This makes it necessary to account for not only political, but also civil society processes. The governance approach allows us to explore aspects inherent in such wider political processes defining distribution of decision-making power – roles and responsibilities, rules and procedures (Kalu, 2012; Marshall, 2013; McCann, 2013). These issues are the heart of REDD+ implementation, but are usually left out in studies of transaction costs.

## 3. Application of the Framework to REDD+ at Local Level

Applying the proposed framework to the two REDD+ pilots – RDS Rio Negro in the state of Amazonas, Brazil and Kilosa in east-central Tanzania, we begin with a description of the methods used for calculating the transaction costs. Thereafter, we present the governance structures and transaction cost generating activities for the two pilots (details in the Appendix). We then present the findings regarding transaction costs in the two cases including a breakdown regarding establishing and using the governance structure, both as total and unit cost estimates.

### 3.1. Methods

The pilots were part of a wider research project also studying REDD+ processes and impacts and involving seven sites across four countries (see Vatn et al., 2016). The selection criteria were; a) that the site had been chosen to pilot REDD+, b) was representative of the country or region and c) had plans to complete the REDD+ process – from consent to payments. Of the seven pilots, we ultimately selected Rio Negro and Kilosa because they had ‘close to’ complete data on transaction costs.

Data were collected in 2012 and 2013. Costs in RDS Rio Negro cover the periods from March 2009 to November 2012 while in Kilosa the period covered runs from September 2009 to February 2013. While the original strategy was to collect data from all actors active in REDD+ activities at the local level, this plan did not materialize because of the large number of actors involved. This was especially a problem in Brazil where the NGO organizing the project collaborated with a broad range of partners, but was less important in Tanzania, as the involved NGOs and communities were the main actors and the NGO staff could assist with data to estimate the costs of other actors.

The main source of cost data were audited accounts from the NGOs implementing REDD+. We also conducted semi-structured interviews with two project managers, three field coordinators and the accounting officer in Kilosa, and two field coordinators, two accounting staff and the research coordinator in RDS Rio Negro. Because they were operating several pilots other than our study sites, costs such as general administrative costs and staff time, had to be specified for our pilots. The NGO staff helped to define fractions regarding the amount of time and resources spent for our pilots. Other costs such as field costs and costs to the residents that were specific to our sites of interest were taken directly from the accounts. Both common and specific costs were further split into fractions and assigned to the different cost categories where applicable. This was, for example, the case when a member of staff carried out activities that covered more than one cost category such as when they facilitated training as well as payment programs.

Added to data obtained through the NGOs, interviews (using translators) were also made with community leaders and members of newly formed committees to get data on costs at community level. We visited four communities in Kilosa and six in Rio Negro and conducted two focus group discussions in each. These costs were calculated as opportunity costs for the time used when engaging in REDD+ activities. All costs were adjusted for inflation. To understand the context under which costs were incurred, we also obtained data on the organization and running of activities in the pilot. An in-depth understanding was, moreover, obtained from other components of the project – as we also have studied the process of establishing the REDD+ projects and its impacts.

Establishment and use costs are summarized as both total and as unit cost estimates. The latter are presented in terms of dollars per ton of avoided greenhouse gas emissions measured as carbon dioxide equivalent (CO<sub>2e</sub>). Estimates of reduced CO<sub>2e</sub> were provided by the NGOs. Estimation was conducted by independent consultants contracted by the NGO (in RDS) and by NGO staff (in Kilosa). The planning horizon was 40 years. These estimates are highly uncertain, but the only basis existing to make comparisons.

The method used for calculating unit costs is the flow summation method, which calculates the unit cost by dividing the total present value of costs by the total amount of carbon expected to be sequestered. A discount rate of 5% is used, supplemented by a sensitivity analysis with discount rates of 7% and 2%. Note that the flow summation method discounts only costs and not the physical carbon. This may be seen as a weakness because it attaches the same value to carbon sequestered in different years. An alternative method would have been the levelization method, which discounts both costs and carbon (see Boscolo et al., 1998; Newell and Stavins, 2000). However, the data available precluded the use of this method because we did not have data on the expected flows of carbon. Instead, as mentioned, the implementing NGOs provided estimates of expected total reductions.

Establishment costs cover the whole setup phase of the pilots, which took approximately four years. The total cost of using the governance structures was estimated by multiplying the ‘use cost’ in the final year of data collection by the planning horizon of 40 years. We used data from the final year of data collection because the pilots took some time to establish (especially in Kilosa), so there were no or minimal ‘use costs’ in the early years. Alternatively, the 4-year average could be multiplied by the planning horizon if the pilots had been ‘running’ for



the whole period covered by the data. Note that this extrapolation assumes a constant annual stream of ‘use costs’ through the 40 years.

### 3.2. Governance Structures

The Bolsa Floresta Program (BFP) in RDS Rio Negro was created as part of the sustainability policy (the Zona Franca Verde or Green Free Zone) for the state of Amazonas. The processes began in 2007 with the drafting of legislation that created the Foundation for Sustainable Amazonas (FAS) as the implementing entity for the BFP in 2008 and the upgrading of the Rio Negro reserve from an environmental protected area to a protection category with stricter regulations, the sustainable development reserve (RDS) in 2009. The state government also provided 20 million Reais<sup>2</sup> as initial funding for the program through the Amazon fund,<sup>3</sup> with Bradesco bank contributing another 20 million (Vatn et al., 2013). As a state protected area, all rules for forest use continue to be formulated by the state. In addition, forest management, monitoring and surveying are the responsibility of the state. Similarly, all land is state owned, although communities are recognized as having the right to occupy and use the land subject to state regulations.

The BFP is organized around four payment components. The family component is a monthly cash transfer to the female heads of families and the social component aims to improve education, health, communication, and transportation and supports cultural and sports programs. The income component, on the other hand, supports production activities in line with the state regulations for resource use in the reserve, while the association component strengthens community associations through participatory forest governance, empowering communities and capacity building programs. This payment system was set up by FAS for all 15 reserves under FAS's operations, although some programs are implemented in partnership with public or private agencies – e.g., Amazonas state health and education departments and private firms.

The project in Kilosa was implemented by the Tanzania Forest Conservation Group (TFCG) in partnership with the Tanzania Community Forest Conservation Network (MJUMITA) (TFCG, 2008). MJUMITA is a national network of community groups involved in participatory forest management (PFM) and its role in this case was to assist communities to develop a carbon enterprise through which they could aggregate carbon emissions and sell them on the international carbon market.

Implementation followed the national guidelines for participatory forest management and the decentralization system. Therefore, TFCG/MJUMITA worked closely with village and district authorities, entities that are legally responsible for implementing PFM. PFM involved creating village natural resource committees, establishing titled village forest reserves, forest management plans, village land-use plans and bylaws defining rules for forest resource use. The NGOs and communities also held meetings to decide on the payment system, by-laws to guide distribution of payments and to set up a revenue sharing committee. The process of setting a carbon enterprise (through MJUMITA) was started, but not complemented within the project time-frame. Similarly, systems for monitoring, reporting and verification (MRV) were set up, but not used because the pilot never made any market sales of carbon. Nevertheless, there was one trial payment. Finally, income-generating activities were part of the strategy to reduce pressures on forests.

Table 2 is a summary of the cost generating activities for establishing and using the above governance structures. We are limited to analyzing establishment and use costs because the pilots were in a stage of establishment so there was yet no costs for maintaining and changing

**Table 2**

Adapting the generic structure of transaction costs categories to the analysis of REDD + pilots in Brazil and Tanzania.

Cost category		Establishing the governance structure	Using the governance structure
1. New and existing institutions	Defining land rights, setting up monitoring systems etc		
2. New and existing actors	Establishment of new associations at local level		
3. Operations by actors	3a. Certifying objects of transfer; monitoring, reporting and verification		
	3b. Processes of resource transfer		
4. General support	4a. Planning and decision making		
	4b. Information/ communication programs		

The cells in grey indicate irrelevant combinations/categories.

the governance structure. There were, however, some costs related to bringing existing organizations and institutions ‘alive’, although we were not able to distinguish these from the cost of establishing new ones.

Category (1) – establishing institutions – concerns costs of defining necessary land rights, developing by-laws for land-use, setting-up of monitoring, reporting and verification (MRV) systems, as well as costs for designing benefit sharing systems and related rules. Costs related to establishing actors (2) regard establishment of new associations or modification of existing ones such as community associations, natural resource committees and cooperatives. Category (3a) regards costs incurred when using the monitoring, reporting and verification system to ascertain adherence to payment criteria, e.g., actual emission reductions. Costs related to resource transfers (3b) include those incurred on using the created payment systems to transfer resources like cash payments or trade in timber. In our case, examples include costs for facilitating the transfer of cash payments and in-kind compensation as well as costs for processing and renewing of legal documents for forest resource use such as forest management plans. Illustrating how demanding it may sometimes be to allocate costs on (establishing) institutions and actors, we had to add a category called ‘general costs’ (4). These are costs covering planning and decision-making (4a) as well as costs for negotiations leading up to the decision to accept or reject REDD +, discussions on how components of the project should be organized, and consultancies to produce strategy documents and technical plans or surveys. They also include costs on information and training programs (4b) like information campaigns for communities and authorities including the costs of public relations and disseminating information. This category also includes what could be termed advocacy costs – i.e., costs incurred by the involved NGOs to influence the REDD + debate. It should be noted that the project carried some general administrative costs – overhead costs including salaries and allowances for administrative staff, costs for auditing, fees and taxes, office costs and capital costs. We have distributed these on the other cost components relative to their size.

### 3.3. Costs of Establishing and Using the Governance Structure

Table 3 offers an overview of the costs of establishing and using the governance structure broken down on the previously defined cost categories.

#### 3.3.1. New and Existing Institutions

RDS Rio Negro did not have any local costs for building or adjusting institutions because the state government had earlier on put the necessary institutional structures in place. The state government for

<sup>2</sup> The value of 1 Reais was about 0.43USD as at 31 December 2008

<sup>3</sup> The Amazon fund was created by the Brazilian government in 2008 to raise and manage financial resources for reducing deforestation in the Brazilian Amazon.

**Table 3**  
Cost breakdown for establishing and using the REDD+ governance structures.

Cost category <sup>a</sup>	RDS Rio Negro				Kilosa			
	Establishment costs (USD)	Use costs (USD)	Total (USD)	%	Establishment costs (USD)	Use costs (USD)	Total (USD)	%
New and existing institutions					851,001		856,404	32.8
New and existing actors	338,247		328,673	11.0	334,860		336,986	12.9
Defining objects of transfer; monitoring, reporting, etc.								
Resource transfer processes		898,550	910,789	30.5		245,084	235,303	9.0
Planning and decision making	335,009	552,855	885,913	29.7	456,476	47,352	504,837	19.3
Information & communication programs	295,404	561,403	856,094	28.7	611,513	66,173	678,927	26.0
Total	968,662	2,012,808	2,981,469	100	2,253,849	358,609	2,612,458	100

<sup>a</sup> Administrative costs are distributed across all cost categories relative to their size.

instance set up the system and rules for use of forest resources such as the requirements and procedures for developing reserve and timber management plans, established rules and procedures for monitoring and enforcement and gazetted the reserve as a sustainable development reserve.

In contrast, the cost of building new and adjusting existing institutions is the largest cost in Kilosa – covering 33% of the total. In Kilosa, this category includes establishing PFM, designing payment systems and establishing MRV mechanisms. PFM include costs of establishing land use plans and corresponding bylaws. They also include the costs of establishing village forest management plans and bylaws. Costs for establishing the payment mechanism included those for organizing village assemblies for selecting the preferred mode of payment and facilitating village council meetings that defined the rules of eligibility for payment. Turning to MRV, the TFCG/MJUMITA project developed the MRV system in accordance with two standards: The Voluntary Carbon Standard and the Climate, Community and Biodiversity Standard. Following the Voluntary Carbon Standard, establishing the MRV system included costs of establishing project baselines using remote sensing and ground measurements consistent with voluntary carbon procedures. They also covered costs of training project staff and the village natural resource committees on ground monitoring and reporting procedures. Costs for setting up the social and biodiversity baseline included costs of training project staff on performing social impact assessments, costs of the village visioning exercise and the costs of carrying out in-depth biodiversity studies.

### 3.3.2. New and Existing Actors

This accounts for about 11% in RDS Rio Negro and 13% in Kilosa. In RDS Rio Negro, this cost was incurred to establish or revamp community associations and establish an association at the reserve level. This includes the costs organizing association meetings, facilitating the election processes and training of community leaders. In Kilosa, the cost was for revamping village natural resource committees and MJUMITA activities such as their annual meetings and board meetings and building MJUMITA networks (carbon enterprise) at village level.

### 3.3.3. Defining Objects of Transfer – i.e., Monitoring, Reporting and Verification

In both pilots, we observed no costs of ‘using’ the MRV system. In Kilosa, this was so because no trade in carbon actually took place before the project ended, while RDS Rio Negro was designed for social development and avoiding deforestation and forest degradation, but not to trade in carbon.

### 3.3.4. Processes of Resource Transfer

For RDS Rio Negro, costs of making resource transfer include those of delivering the cards to families as well as the cost of delivering and installing of in-kind payments such as radio communication systems, boats, radios, ambulances as well as expenses for meetings, workshops

and trainings related to payments. They also include costs for using institutions built to trade timber including the development of timber management plans, costs for processing licenses and for the carrying out of forest inventories. This cost thus comprises the cost of assisting the communities to process timber management plans, including logistical expenses for meetings, workshops and trainings on the plans. The license fee as well as the transport expenses incurred by the communities in preparing the necessary documentation is also included. In Kilosa, costs on resource transfer regards those for undertaking the trial payment as well as establishing and running income projects including agricultural activities, bee keeping and improved cooking stoves. Transaction costs for resource-transfers amounted to about 31% in RDS Rio Negro and 9% in Kilosa.

### 3.3.5. Planning and Decision-Making

RDS Rio Negro incurred a higher fraction (30%) as compared to Kilosa (19%) on this cost category. The bulk of these costs in the RDS were expenses for organizing meetings where community members planned and decided (mostly) on how to allocate resources to the BF-Income and BF-Social components. Some costs were also associated with the preliminary socio-economic survey and costs for the consent process such as those related to the workshop where the female head of the household signed the contract with FAS to join the project. The latter costs were, however, rather low. In Kilosa, the category includes consultancy costs for selecting of REDD+ sites, preparing evaluation plans and planning the setting up of REDD+ baselines, MRV programs and performance indicators etc. In Kilosa, the consent process involved initial consultations between TFCG/MJUMITA and the local district officials and residents.

### 3.3.6. Information Programs and Communication

This category accounts for 29% of the total cost in RDS and 26% in Kilosa. In RDS Rio Negro, it includes the cost for training communities and successive workshops aimed at informing residents about the BFP. Training programs are mainly related to income generating projects such as handicrafts, tourism, agriculture, aviculture etc. This also includes the cost of advertising and public relations. In Kilosa, on the other hand, this category includes costs of training programs, TV and radio programs, policy briefs and newsletters. We have also included costs for advocacy. These costs were mostly for participation in international and national REDD+ advocacy events and REDD+ related meetings.

## 3.4. Unit Costs for Establishing and Using the Governance Structures

Unit costs for establishing and running the REDD+ pilots are presented in Table 4. At a 5% discount rate, the establishment cost was 0.5 USD per ton of expected reductions in carbon emissions in RDS Rio Negro and 1.8 USD per ton in Kilosa, while the use cost was 2 USD per ton in RDS Rio Negro and 0.6 USD per ton in Kilosa. Thus, the cost of

**Table 4**

Unit costs for establishing and using the governance structure.

	RDS Rio Negro			Kilosa		
Discount rate	7%	5%	2%	7%	5%	2%
Establishment cost (USD/tCO <sub>2</sub> e)	0.5	0.5	0.6	1.7	1.8	1.9
Use cost (USD/tCO <sub>2</sub> e)	0.9	2.0	6.4	0.3	0.6	2.0
Total	1.4	2.5	7.0	2.0	2.4	3.9

establishing REDD+ in Kilosa was more than three times the cost incurred in RDS Rio Negro, while the using cost for Kilosa was about a third of that in RDS Rio Negro.

Overall, the total cost was estimated at 2.5 and 2.4 USD per ton in RDS Rio Negro and Kilosa respectively, at 5% discount rate. Results from the sensitivity analysis show that as the discount rate decreases from 7% to 2%, the unit using cost increases from 1 to 6 USD per ton of carbon in RDS Rio Negro and from 0.3 to 2 USD per ton in Kilosa. Similarly, total unit costs increased 5 times in RDS Rio Negro and about two times in Kilosa as the discount rates decreased from 7 to 2%.

To put our findings in context, the prevailing price on the voluntary carbon market for REDD+ projects that protect forests from small-holder threats<sup>4</sup> is about 5 USD per ton<sup>5</sup> (Hamrick and Brotto, 2017). Three caveats are important as we interpret and draw conclusions from these results. First, the amount of reduced carbon is very uncertain, as the actual quantity sequestered will depend on the extent to which the pilots are able to implement the expected management practices in the future. As such, the costs could increase or decrease depending on how REDD+ is eventually implemented/enforced. Relatedly, since estimated carbon reductions were provided by the NGOs, it is probable that the methods used were different in the two pilots and carbon estimates incomparable. Then, the carbon enterprise in Kilosa had not started selling carbon by the time we collected the data. For this reason, the results underestimate the using cost in Kilosa. Finally, while the summary estimates are based on carbon, we note that benefits in the Brazilian case are much broader, as the pilot also offers social development programs.

#### 4. Discussion

In order to have a holistic assessment of transaction costs, we have recommended a conceptual framework based on governance structures. Below we discuss the findings from using the proposed framework to analyze transaction costs of implementing REDD+. Before we start on that endeavor, keep in mind that there were establishment costs incurred by public authorities prior to implementation. In RDS Rio Negro, the BFP with its administrative actors and the institutions around the RDS were already set up, while the Kilosa pilot drew on already established guidelines for PFM and decentralization systems.

We found that the unit cost of establishing REDD+ governance structures was higher in Kilosa, while RDS Rio Negro had a higher unit cost of using the governance structures. That is, establishment costs were in the range of USD 1.7 and 1.9 in Kilosa and USD 0.5 and 0.6 in RDS Rio Negro per ton of expected reduced CO<sub>2</sub> emissions, depending on the discount rate used. On the other hand, using costs ranged between USD 0.9 and 6.4 in RDS Rio Negro and USD 0.3 and 2.0 per ton of expected CO<sub>2</sub> sequestered in Kilosa.

The cost variations in the two pilots seem to come from the

<sup>4</sup> Smallholder threats refer to activities such as subsistence agriculture, live-stock grazing, collection of fuelwood charcoal, illegal logging, and small-scale extractive activities.

<sup>5</sup> Ideally, this price should be compared to the total cost i.e. sum of transaction, production and opportunity costs. We, nevertheless, could not compare the carbon price to the total cost because we lacked any reliable data on production and opportunity costs.

differences in the types of transactions pursued. REDD+ in Kilosa was primarily directed at organizing an economic transaction, aimed to position the pilot as a participant in the global carbon market. Effecting the carbon trade nevertheless demanded first political and to some extent civil society processes, defining who owns the carbon, how performance is to be monitored and verified and how payments should be made. Thus, added to the selection of REDD+ sites, it necessitated the defining of property rights, preparation of baselines and building of the carbon cooperative, all of which had to be set up from 'scratch'. In contrast, the state of Amazonas founded the BFP in RDS Rio Negro mainly as a social development and conservation program, without the goal of trading carbon. There were, however, aspects of an economic transaction as communities were to receive transfers in return for following certain rules including those aimed at reducing deforestation and forest degradation. Moreover, BFP also exhibited political and civil society transactions as the state government established FAS, constructed the legal basis for the BFP and made a monetary contribution to start the program. As important was the designation of the project area to a sustainable development reserve. Consequently, the costs for establishing the BFP in RDS Rio Negro were heavily subsidized by the state government.

Analyzing transaction costs based on governance structures, therefore, implies a recognition that all three types of transactions entail transaction costs. While some analysts consider only expenditures necessary to facilitate participation in the carbon market, results from this study show that this approach excludes a significant portion of costs generated by political and civil society transactions. Transaction costs of projects like REDD+ should, therefore, not only include search, negotiation, enforcement, monitoring, reporting, verification and certification costs (e.g., Pagiola and Bosquest, 2009; White and Minang, 2011; Merger et al., 2012). Also costs of collective decision-making, developing or changing institutions/rules and actors, election of representatives, capacity building, advocacy, conflict resolution as well as administration costs to support these processes (e.g., Thompson et al. 2013; Mrutu et al., 2016) should be incorporated.

Our approach also enables a better understanding of the distributive aspects of environmental policy, because it maps all costs incurred by the various actors involved. In this case, we find that the contribution of the state government in setting up the project heavily subsidized the costs for establishing the BFP in RDS Rio Negro resulting in the unit establishment cost in RDS Rio Negro being less than 1/3 of that in Kilosa. An exclusive focus on economic transactions would preclude such a realistic assessment of transaction costs. For instance, Luttrell et al. (2018) found that most official budgets of REDD+ initiatives cover only costs of deciding on participation, monitoring, reporting and verification and direct payments to host communities, while costs of administration, institutional arrangements and enforcement that are borne by national and sub-national actors are generally not covered. The authors suggest that the exclusion of the latter costs, compromises the design and sustainability of REDD+.

Acknowledging the existence of the different types of transactions also has implications for our understanding of the factors that influence transaction costs. Currently, most analysts refer to Williamson's framework, citing transaction characteristics, transactor characteristics and institutional environment as important determinants of transaction costs. While this approach has provided useful insights, it has also been limiting because its orientation towards explaining the organization of economic activity, may not be seamlessly extended to the public sphere (Ruiter, 2005). The key transaction characteristics, asset specificity, frequency and uncertainty may for example not be the most relevant for environmental policy (McCann et al., 2005). A more appropriate approach would be to distinguish between the unique attributes of economic, political and civil transactions that influence transaction costs as the characteristics of the three transaction types maybe different, the characteristics of actors not necessarily similar, and the institutions guiding interactions could also differ.

Regarding actor characteristics, Gallemore et al. (2015) have for example demonstrated the role of political power and trust in influencing political transaction costs of REDD+ policy. Scartascini (2007) also suggests that strong political power may reduce transaction costs by enabling leaders to bypass negotiation and bargaining. Indeed, our results seem to support these arguments as we also find that the power wielded by the Amazonas state government was in part responsible for reducing the transaction costs of establishing the BFP in RDS Rio Negro. Unfortunately, our findings elsewhere (Nantongo, 2017; Vatn et al., 2013, 2017) also indicate that the process of project implementation in RDS Rio Negro was less legitimate than in Kilosa, which means that the transaction cost saving observed here, could have been achieved at the expense of legitimacy in terms of the quality of decision-making processes. It implies therefore, that it is important to address equity issues. Although this may entail higher transaction costs in the set-up stage, it might decrease using costs through increasing compliance and reducing leakage, thereby contributing to the long-term sustainability of the policy.

This highlights a fundamental issue, which is how to deal with the potential tradeoffs or synergies between efficiency and other policy goals such as equity and effectiveness (see Hanna, 1995). Within the neoclassical and new institutional traditions, the focus is on obtaining least-cost solutions. This, complicates the task of investigating tradeoffs or synergies. We suggest that governance is a more helpful approach because it recognizes that actors could have diverse interests, values and motivations so that the choice of governance structures is not always only a matter of efficiency, but also effectiveness and equity considerations (Paavola, 2007). Several studies of market-based instruments have acknowledged the role of participants who do not (traditionally) carry out market functions and the prevalence of non-market policies (e.g. Stavins, 1995; Dudek and Wiener, 1996; Milne, 1999; Carrington, 2000; Cacho et al., 2013; Vega and Keenan, 2014). In such situations, motivations other than efficiency may be prevalent. Vega and Keenan (2016) have for example found that self-determination, resource control and political representation are among the motivating factors for participants in commercial community forestry. In the same vein, this study also finds that distributive equity was a key policy goal for the BFP as the state government of Amazonas aimed to reverse social underdevelopment among communities in the Amazon. This had consequences for transaction costs because the development focus of the program required a broad human resource base in education, health, forest management, child development etc. to cater for all four components of the BFP. Moreover, in addition to the human resource needs of FAS, the communities also had to be trained in a broad array of social investments. The result was an increase in the unit costs of using the governance structures in RDS Rio Negro. In comparison, Kilosa had a narrower focus on carbon and as such, REDD+ implementation needed a narrower staff base with specific knowledge on carbon measurement, cooperative management and building alternative incomes. These differences lowered the unit using costs in Kilosa.

Relatedly, the diverse payment package in RDS Rio Negro raised using costs. This is reflected in the high decision-making costs of community meetings to decide on the alternative social investments and high resource-transfer costs for managing the wide portfolio of transfers. Kilosa on the other hand had a less demanding payment structure, resulting in lower costs for using the governance structure. Moreover, while RDS Rio Negro had monthly and yearly payments, a trial payment was made only once in Kilosa. Note, however, that since there are no costs for MRV and transacting via the carbon enterprise, using costs are underestimated in Kilosa.

Concerning the effect of the institutional environment on transaction costs, we note that new institutional economics already has a deep enough framework to facilitate the analysis of both formal and informal institutions in the economic, political and civil society spheres (North, 1992; Williamson, 2000). Our analysis, however, concludes that these various institutions exist not only to shape economic performance, but

also to support a variety of interests in the political or civil spheres. It also means that institutions for regulating markets may be different from those necessary for either political or civil transactions. This has important ramifications for transaction costs. In the Brazilian case, for example, the goal was not to trade carbon so there was no need of defining property rights. Instead, the political and civil society processes identified, the issue of preventing the growing economic activity from encroaching on the reserve as the most pressing institutional concern (Viana, 2010). To address this challenge, the state government instituted legislation, resulting in the upgrading of the reserve from an Environmental Protection Area (APA) to a Sustainable Development Reserve (RDS), establishing FAS and the BFP and financing part of the start-up cost. Kilosa, however, faced a challenge of unclear land ownership between the central government, the district and the villages. Yet as an economic transaction, land tenure had to be formalized in order to qualify for payments on the carbon market. There was, therefore, a dire need for land demarcation through creating village forest reserves and land use plans. Consequently, the Kilosa project had a higher unit cost of establishing REDD+ compared to the project in the RDS, as costs in the latter had earlier on been met by the state government.

Moreover, to meet the key objective of trading on the carbon market, TFCG/MJUMITA had to develop a comprehensive 'package' of institutions such as an MRV system for monitoring performance and defining property rights. There were also meetings to draft and approve bylaws for forest use and training of forest patrol teams to enforce them. In contrast, RDS Rio Negro did not employ the strict procedures for enforcement, monitoring and verification seen in Kilosa. As the goal was to simply curb deforestation and degradation, the BFP instead opted for free satellite imagery from the National Institute of Space Research to monitor changes in deforestation and leveraged the State Centre for Protected Areas and the community to patrol forests for illegal activity. Therefore, there were no local level costs for institutional building in RDS Rio Negro. The result was an upward effect on establishment in Kilosa and a downward effect in RDS Rio Negro.

Finally, we point out that the cost estimates are uncertain due the costs not included – partly because of investments already made before the programs analyzed were started (e.g., the costs of setting up Bolsa Floresta in the first place) and partly because of incomplete development of the programs. The latter refers specifically to Kilosa where there was only a trial payment. The verification process was not completed and no trade of carbon was in the end made. To facilitate comparisons between the projects, we also estimated some per unit costs. Here, the lack of actual data on emissions – having to use a prognosis for the expected reductions – creates a great uncertainty. While no alternatives exist for such a strategy, we believe the problems it causes are more important for the absolute levels of estimated transaction costs and less problematic regarding the comparison between the two cases.

## 5. Conclusion

REDD+ is suggested as an inexpensive strategy for mitigating climate change. Nevertheless, some have questioned whether this assertion is true arguing that transaction costs are excluded or undervalued in cost studies. In this paper, we argue that since transactions are diverse and operate in a wide variety of circumstances, the lack of a common framework and methodology for assessing transaction costs, may be a key explanation for this fact. We thus propose a framework that we believe suits various types of transactions and contexts and exemplify it by estimating transaction costs incurred for REDD+ pilots in Rio Negro, Brazil and Kilosa, Tanzania.

We build this framework upon the concept of governance structures, with actors and institutions as the building blocks. Given this, we define transaction costs as the costs of establishing, maintaining, changing and using a governance structure. Depending on the kind of institutions, actors interact in different ways resulting in different types of



transactions either economic, political or civil society transactions. In economic transactions, actors interact mainly through trade and command, but they could also donate, cooperate or reciprocate. In political transactions, interactions include specifying property rights, public monitoring, enforcement, and litigation, but also elections, contracting of government services and other interactions between the public leadership at various levels. Finally, civil society transactions involve interactions among civil society and between civil society and political actors through elections, dissemination of information, political debate/communication, advocacy or mediation. The diverse types of interactions give rise to different governance structures.

Results indicate higher unit costs – costs per ton of reduced CO<sub>2</sub> – of establishing the REDD+ governance structures in Kilosa, while unit costs of using those structures are higher in RDS Rio Negro. We think this conclusion is robust, while the absolute levels calculated are uncertain. This is mainly because the data on emission reductions are based on estimates made at the time of starting the projects. Given these estimates, establishment costs were in the range of USD 0.5 and 0.6 in RDS Rio Negro and USD 1.7 and 1.9 per ton of expected reduced CO<sub>2</sub> emissions in Kilosa. Alternatively, using costs ranged between USD 0.9 and 6.4 in RDS Rio Negro and USD 0.3 and 2.0 per ton of expected CO<sub>2</sub> sequestered in Kilosa, depending on the discount rate used. Total transaction costs were between USD 1.4 and 7.0 in RDS Rio Negro and USD 2.0 and 3.9 in Kilosa, around the same magnitude as the prevailing carbon price of 5 USD per ton of carbon. Considering that costs have been underestimated (especially in Kilosa), these transaction cost estimates seem to indicate that REDD+ is probably not as low-cost as was originally hoped. In the end, the cost-effectiveness of REDD+ will depend not least on how successful projects will be at curbing deforestation. This is, however, difficult to assess at present.

Cost variations in the two pilots arose mainly from the differences in the types of transactions pursued in the two pilots, as the transactions required different institutions and actors and demanded to be organized through different processes. Thus, while REDD+ was earlier envisaged as an economic transaction – a performance-based system where producers were meant to deliver carbon storage to buyers against a payment, – in practice REDD+ has exhibited also political and civil society transactions at varying degrees depending on the context in which it operates. Ultimately, what it takes to build carbon trade – as in Kilosa – is different from what it takes to pay people according to agreed rules, but without the need to abide by the rules of the carbon market – as was the case in RDS Rio Negro.

Therefore, common assertions that REDD+ is cost-effective because it is a market-based solution may be misleading. REDD+ could take the form of a market, e.g., direct trade between buyers and sellers, a non-market governance structure e.g., transfers between governments or a mixture of market and non-market elements. It is therefore more appropriate to consider the efficiency of REDD+ based on the governance structure that it adopts.

Although the framework developed here is used in the context of REDD+ and with a focus on local costs, it is suitable for assessing transaction costs for environmental policies more generally and can be used at various levels of socio-economic organization. The framework, we believe, is an important contribution at the conceptual level. Use costs have for instance not been a common object of analysis, yet as we show, they can be substantial, at times perhaps larger than set-up costs. Moreover the relative sizes of the two cost categories (establishment and use costs) could be important for understanding important trade-offs (synergies) between equity, effectiveness and efficiency. Empirically however, the format of available data may not permit splitting costs with respect to the defined categories. This is moreover a general problem, independent of the framework. It is more dependent on data collection methods. Gathering data during policy planning and implementation offers further opportunities to split costs than if one – as in our case – had to build the analysis on various types of records. One should also be cognizant of the limitations surrounding the

empirics in the concrete case. These include (i) the fact that the carbon figures used are only estimates, not actual emission reductions, (ii) that methods for calculating carbon estimates could be different in the two pilots and, (iii) that costs in Kilosa could be underestimated because we do not fully capture MRV costs and costs for making resource transfers. All these present uncertainties for the final cost estimates and imply a cautious interpretation of the results.

## Acknowledgements

This work was financially supported by the Research Council of Norway. The Schlumberger Foundation also provided a fellowship award that further supported the research. In addition, we are grateful to our research partners from Sokoine University of Agriculture, Tanzania and the Foundation for Sustainable Amazonas, Brazil for the assistance provided in data collection. The master students at the Norwegian University of Life Sciences are also appreciated for participating in the data collection. We also thank the project implementers, the local government authorities and the communities for accepting to speak with us. Finally, we are grateful to the two anonymous reviewers for commenting on the paper.

## Appendix A. Appendix

### REDD+ implementation in RDS Rio Negro

FAS began implementing<sup>6</sup> REDD+ in the Rio Negro RDS at the beginning of 2009 – a few months after the state government upgraded the reserve – implying stricter regulations – from an Environmental Protection Area (APA) to a Sustainable Development Reserve (RDS). The process of establishing the BFP in the area started with a socio-economic survey and registration of families. Community members from the three Polos then attended a joint introductory workshop organized by FAS where information about the BFP, REDD+ and climate change in general was given. At the end of this meeting, households that wanted to join, represented by the female head, signed a contract with FAS – i.e., BF-Family. The FAS field team later returned to the communities on different occasions to deliver the BFP membership cards – which are also used as ATM cards – to the families. From then on, families began to receive their monthly payment of the BF-family. The money is withdrawn from a Bradesco bank ATM machine in the nearest town. In order to minimize transportation costs, community members reported that they either collect the money when they make trips for other duties in the town or they can ask a family member or friend that may be going to the town to collect the money on their behalf.

Between May 2009 and June 2010 5 more workshops were held, sometimes jointly or for specific communities. On average, each workshop lasted 3–4 days. At the first workshop, which was attended by members from all three Polos, the communities formed an organization at the RDS level. The process was facilitated by FAS. Community members also elected a board for the association and made decisions on its rules. The rules had been drafted by community leaders prior to the workshop. Decisions on investment priorities for the BF-social and BF-Income were also made at this workshop.

Two other workshops on forest management plans were held. At these workshops, the communities received training on how to develop and use the forest management plans for legal extraction of timber. These plans have to be approved by IPAAM – the Institute of Environmental Protection of the State of Amazonas (a government agency) – and a license is then issued to the community. The licenses are to be renewed every two years. A point to note here is that this

<sup>6</sup> For details and evaluation of the process of introducing REDD+ in RDS Rio Negro, refer to Vatn et al. (2013)

institutional development involves multilateral cooperation between FAS and its partners. For example at the workshops, training is given by FAS together with technical agencies such as IDAM – the Institute of Agricultural Development and Sustainable Forestry of the State of Amazonas – or state government bodies like CETAM – the Center of Technological Education of Amazonas – and IPAAM. These bodies also provide technical support for carrying out forest inventories. Similarly, FAS, together with a private firm Camargo Correa Institute, covers some of the costs involved in the process of obtaining the licenses for wood management that would have been incurred by the community.

The two final workshops were mainly concerned with use and management of the assets that had been received by the communities under the BF-Social.<sup>7</sup> Here, information on the rules of use for the assets were given. In addition to these introductory workshops, FAS organizes at least 5 workshops in each Polo and a community-level association meeting annually. The Polo level workshops include capacity building workshops for community leaders and members, trainings on income activities and meetings to make investment decisions.

### A.1. REDD+ implementation in Kilosa

The process of introducing REDD+ started in September 2009 with meetings at which TFCG/MJUMITA officials introduced the project to representatives of the Kilosa district authorities. As an outcome of these meetings, a REDD+ facilitation team comprising of district officers and TFCG/MJUMITA staff was formed. The next step was to invite villages to engage in REDD+. This started with meetings between the facilitation team and the village council informing about the REDD+ project. Next, sub-village level meetings were held where members of the community were informed about the meaning and benefits of REDD+ and how it could be implemented in the village. Participants at sub-village meetings also suggested representatives for the village natural resource committee. A village general assembly was then held. Here the village decided to accept or reject the project by a majority voice rising. The village assembly then endorsed the members of the village natural resource committee that had been proposed at the sub-village meeting.

Formalising property rights was important for trading carbon. Yet, while villages had customary rights to the land, village boundaries were not defined. Therefore, land rights had to be formalized and land use plans established. Implementing REDD+ in the Kilosa REDD+ pilot was therefore based on establishing PFM in the villages. This was done through a process defined by national PFM guidelines (MNRT-FBD, 2007). Land use planning was carried out by members of the village natural resource committee and TFCG/MJUMITA staff. Then, TFCG/MJUMITA, village natural resource committees and the village councils drafted a proposal of village boundaries and REDD+ by-laws on the use of resources from the forest. A village assembly was again called to amend – if the villagers found it necessary – and approve the draft proposal. If endorsed, the proposal was then forwarded to the district council. Finally, the proposal was sent to Commissioner of Land for final approval. At the same time, TFCG/MJUMITA began to facilitate the establishment of income generation activities such as improved agricultural practices, beekeeping, chicken rearing and use of improved stoves. Decisions on which activities to prioritize were again made at a general assembly.

The process of introducing payments as compensation for lost livelihoods was carried out next. At a general assembly, the villagers chose between 3 options of benefit sharing arrangements a) the individual dividend for everybody older than 6 months of age b) payments to community development projects and c) payments to village natural resource committee projects. A village general assembly was again convened to decide on the by-laws for payments specifying who was eligible to be paid, what fraction of the payment should be used for

development projects and instituting a REDD+ revenue sharing committee. A so-called trial payment was made in 2011 with the revenue sharing committee making the payments at a sub-village meeting. Because the goal was to enter the carbon market, the trial payment mimicked the payment system on the carbon market. Thus, calculation of the level of payment was made by TFCG/MJUMITA by taking into account factors such as the historical deforestation rate and the potential avoided deforestation, interventions put in place to avoid deforestation, the likelihood for leakage and estimated price of carbon (Mosi, 2013).

### References

- Abdullah, N.M.R., Kuperan, K., Pomeroy, R.S., 1998. Transaction costs and fisheries co-management. *Mar. Resour. Econ.* 13 (2), 103–114.
- Allen, D.W., 1999. Transaction costs. In: *Encyclopedia of Law and Economics*, pp. 893–926.
- Realising REDD+. National strategy and policy options. In: Angelsen, A., Brockhaus, M., Kanninen, M., Sills, E., Sunderlin, W.D., Wertz-Kanounnikoff, S. (Eds.), *The REDD+ Idea Meets Reality*. CIFOR, Bogor, Indonesia.
- Antinori, C., Sathaye, J., 2007. Assessing Transaction Costs of Project-Based Greenhouse Gas Emissions Trading. Lawrence Berkeley National Laboratory, Berkeley, CA.
- Bäckstrand, K., 2006. Multi-stakeholder partnerships for sustainable development: rethinking legitimacy: accountability and effectiveness. *Eur. Environ.* 16, 290–306.
- Berkes, F., 2007. Community-based conservation in a globalized world. *Proc. Natl. Acad. Sci.* 104 (39), 15188–15193.
- Boscolo, M., Vincent, J.R., Panayotou, T., 1998. Discounting costs and benefits in carbon sequestration projects: Harvard Institute for International Development. Harvard University.
- Buitelaar, E., 2004. A transaction-cost analysis of the land development process. *Urban Stud.* 41 (13), 2539–2553.
- Cacho, O.J., Lipper, L., Moss, J., 2013. Transaction costs of carbon offset projects: a comparative study. *Ecol. Econ.* 88, 232–243.
- Carrington, M., 2000. A Business View on Key Issues Relating to the Kyoto Mechanisms, Study Funded by UK Department for Environment. Transport and Regions Price WaterhouseCoopers, London.
- Coase, R.H., 1937. The nature of the firm. *Economica* 4 (16), 386–405.
- Coase, R.H., 1960. The problem of social cost. *J. Law Econ.* 3 (1), 1–44.
- Coggan, A., Whitten, S.M., Bennett, J., 2010. Influences of transaction costs in environmental policy. *Ecol. Econ.* 69 (9), 1777–1784.
- Coggan, A., Buitelaar, E., Whitten, S., Bennett, J., 2013. Factors that influence transaction costs in development offsets: who bears what and why? *Ecol. Econ.* 88, 222–231.
- Colby, B.G., 2000. Cap-and-trade policy challenges: a tale of three markets. *Land Econ.* 76 (4), 638–658.
- Dahlman, C.J., 1979. The problem of externality. *J. Law Econ.* 22 (1), 141–162.
- Dawkins, C.J., 2000. Transaction costs and the land use planning process. *J. Plan. Lit.* 14, 507.
- De Alessi, L., 1983. Property rights, transaction costs, and X-efficiency: an essay in economic theory. *Am. Econ. Rev.* 73 (1), 64–81.
- Demsetz, H., 1964. The exchange and enforcement of property rights. *J. Law Econ.* 7, 11–26.
- Di Gregorio, M., Brockhaus, M., Cronin, T., Muharrom, E., Santoso, L., Mardiah, S., Büdenbender, M., 2013. Equity and REDD+ in the media: a comparative analysis of policy discourses. *Ecol. Soc.* 18 (2).
- Dudek, D.J., Wiener, J.B., 1996. Joint implementation, transaction costs and climate change: Organisation for Economic Cooperation and Development (OECD/GD). <http://www.oecd.org/environment/cc/2392058.pdf>.
- Eggertsson, T., 1990. The role of transaction costs and property rights in economic analysis. *Eur. Econ. Rev.* 34, 450–457.
- Fosci, M., 2013. Balance sheet in the REDD+: are global estimates measuring the wrong costs? *Ecol. Econ.* 89, 196–200.
- Galik, C.S., Cooley, D.M., Baker, J.S., 2012. Analysis of the production and transaction costs of forest carbon offset projects in the USA. *J. Environ. Manag.* 112, 128–136.
- Gallemlere, C., Di Gregorio, M., Moeliono, M., Brockhaus, M., 2015. Transaction costs, power, and multi-level forest governance in Indonesia. *Ecol. Econ.* 114, 168–179.
- Gsottbauer, E., van den Bergh, J.C., 2011. Environmental policy theory given bounded rationality and other-regarding preferences. *Environ. Resour. Econ.* 49 (2), 263–304.
- Hamrick, K., Brotto, L., 2017. State of European Markets 2017. Voluntary Carbon, Washington, DC. <http://forest-trends.org/releases/p/state-of-european-markets-2017>.
- Hanna, S., 1995. Efficiencies of user participation in natural resource management. In: Hanna, S., Munasinghe, M. (Eds.), *Property Rights and the Environment: Social and Ecological Issues*. Beijer International Institute of Ecological Economics and the World Bank, Washington, D.C., pp. 59–67.
- Jones, J.P., Andriamarovololona, M.M., Hockley, N., 2008. The importance of taboos and social norms to conservation in Madagascar. *Conserv. Biol.* 22 (4), 976–986.
- Kalu, K.N., 2012. All that glitters: competing narratives and transaction costs in complex collaborative environments. *Adm. Soc.* 45 (4), 420–442.
- Lemos, M.C., Agrawal, A., 2006. Environmental governance. *Annu. Rev. Environ. Resour.* 31.
- Luttrell, C., Sills, E., Aryani, R., Ekaputri, A.D., Evinke, M.F., 2018. Beyond opportunity costs: who bears the implementation costs of reducing emissions from deforestation

<sup>7</sup> Some further training on management plans was given

- and degradation? Mitig. Adapt. Strateg. Glob. Chang. 23 (2), 291–310.
- Marshall, G.R., 2013. Transaction costs, collective action and adaptation in managing complex social–ecological systems. *Ecol. Econ.* 88, 185–194.
- McCann, L., 2013. Transaction costs and environmental policy design. *Ecol. Econ.* 88, 253–262.
- McCann, L., Easter, W., 2000. Estimates of public sector transaction costs in NRCS programs. *J. Agric. Appl. Econ.* 32 (2), 555–563.
- McCann, L., Colby, B., Easter, K.W., Kasterine, A., Kuperan, K.V., 2005. Transaction cost measurement for evaluating environmental policies. *Ecol. Econ.* 52 (4), 527–542.
- Merger, E., Held, C., Tennigkeit, T., Blomley, T., 2012. A bottom-up approach to estimating cost elements of REDD+ pilot projects in Tanzania. *Carbon Balance Manag.* 7 (1), 9.
- Milne, M., 1999. Transaction Costs of Forest Carbon Projects. Center for International Forestry Research (CIFOR).
- MNRT-FBD, 2007. Community Based Forest Management Guidelines: For the Establishment of Village Land Forest Reserves and Community Forest Reserves. Ministry of Natural Resources and Tourism, Forest and Bee Keeping Division (MNRT-FBD), Dar es Salaam. United Republic of Tanzania.
- Moe, T.M., 1990. Political institutions: the neglected side of the story. *J. Law Econ. Org.* 6, 213–253.
- Mosi, E.C., 2013. An Assessment of the Introduction of REDD+ in Tanzania. A Case Study of the TFCG/MJUMITA REDD+ Pilot Project in the Kilosa District. Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (Master thesis).
- Mrutu, M., Kessy, J.F., Ngaga, Y.M., Temu, B.J., 2016. Analysis of transaction costs for REDD+ trial payment scheme in Kilosa District, Tanzania. *J. Environ. Soc. Sci.* 2 (2), 117.
- Nantongo, M., 2017. Legitimacy of local REDD+ processes. A comparative analysis of pilot projects in Brazil and Tanzania. *Environ. Sci. Pol.* 78, 81–88.
- Newell, R.G., Stavins, R.N., 2000. Climate change and forest sinks: factors affecting the costs of carbon sequestration. *J. Environ. Econ. Manag.* 40 (3), 211–235.
- Niehans, J., 1987. Transaction Costs. In: Eatwell, John, Milgate, Murray, Newman, Peter (Eds.), *The New Palgrave: A Dictionary of Economics*. Macmillan, London, pp. 676–679.
- North, D.C., 1992. Transaction Costs, Institutions, and Economic Performance. ICS Press, San Francisco, CA, pp. 13–15.
- Ostrom, E., 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.
- Paavola, J., 2002. Rethinking the choice and performance of environmental policies. In: Bromley, D.W., Paavola, J. (Eds.), *Economics, Ethics, and Environmental Policy: Contested Choices*. Blackwell, Malden, MA.
- Paavola, J., 2007. Institutions and environmental governance: a reconceptualization. *Ecol. Econ.* 63 (1), 93–103.
- Paavola, J., 2016. Multi-level environmental governance: exploring the economic explanations. *Environ. Policy Gov.* 26 (3), 143–154.
- Pagiola, S., Bosquest, B., 2009. Estimating the Costs of REDD at the Country Level: Forest Carbon Partnership Facility. World Bank. [https://www.forestcarbonpartnership.org/sites/forestcarbonpartnership.org/files/REDD-Econ\\_04-09-09.pdf](https://www.forestcarbonpartnership.org/sites/forestcarbonpartnership.org/files/REDD-Econ_04-09-09.pdf).
- Pearson, T., R. H., Brown, S., Sohngen, B., Henman, J., Ohrel, S., 2013. Transaction costs for carbon sequestration projects in the tropical forest sector. *Mitig. Adapt. Strateg. Clim. Chang.* 19 (8), 1209–1222.
- Phan, T.H.D., Brouwer, R., Davidson, M.D., 2017. A global survey and review of the determinants of transaction costs of forestry carbon projects. *Ecol. Econ.* 133, 1–10.
- Pigou, A.C., 1920. *The Economics of Welfare*. MacMillan, London.
- Pollak, R.A., 1985. A transaction cost approach to families and households. *J. Econ. Lit.* 23 (2), 581–608.
- Rakatama, A., Pandit, R., Ma, C., Iftekhar, S., 2017. The costs and benefits of REDD+: a review of the literature. *Forest Policy Econ.* 75, 103–111.
- Rørstad, P.K., Vatn, A., Kvakkestad, V., 2007. Why do transaction costs of agricultural policies vary? *Agric. Econ.* 36 (1), 1–11.
- Ruiter, D.W., 2005. Is transaction cost economics applicable to public governance? *Eur. J. Law Econ.* 20 (3), 287–303.
- Scartascini, C., 2007. The Institutional Determinants of Political Transactions. Working Paper Series, 580 Inter-American Development Bank, Washington D.C.
- Stavins, R.N., 1995. Transaction costs and tradeable permits. *J. Environ. Econ. Manag.* 29 (2), 133–148.
- Stern, N., 2007. *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge UK, pp. 537.
- Stern, N., 2008. The economics of climate change. *Am. Econ. Rev.* 98 (2), 1–37.
- TFCG, 2008. Tanzania Forest Conservation Group, Making REDD and the Carbon Market work for Communities and Forest Conservation in Tanzania. A Project Proposal Presented to the Royal Norwegian Embassy. Salaam, Dar es.
- Thompson, D.B., 1999. Beyond benefit-cost analysis: institutional transaction costs and regulation of water quality. *Nat. Resour. J.* 517–541.
- Thompson, O.R., Paavola, J., Healey, J., Jones, J., Baker, T., Torres, J., 2013. Reducing emissions from deforestation and forest degradation (REDD+): Transaction costs of six Peruvian projects. *Ecol. Soc.* 18 (1).
- Vatn, A., 2010. An institutional analysis of payments for environmental services. *Ecol. Econ.* 69 (6), 1245–1252.
- Vatn, A., 2014. Markets in environmental governance. From theory to practice. *Ecol. Econ.* 105, 97–105.
- Vatn, A., 2015. A framework for analyzing environmental governance systems. In: *Environmental Governance*. Edward Elgar Publishing Limited, Northampton, USA, pp. 143–153.
- Vatn, A., Kajembe, G., Leiva-Montoya, R., Mosi, E., Nantongo, M., Silayo, D.S., 2013. Instituting REDD+. An Analysis of the Processes and Outcomes of Two Pilot Projects in Brazil and Tanzania. International Institute for Environment and Development (IIED), London. <http://pubs.iied.org/pdfs/G03720.pdf>.
- Vatn, A., Kajembe, G., Kjosavik, D., Nabanoga, G., Namaalwa, J., Nantongo, M.G., Samndong, A.R., Silayo, D.S., Soka, G., Ssenyonjo, E., Vedeld, P., 2016. REDD+ Piloting Processes and Impacts. Experiences from pilot projects in Brazil, Democratic Republic of Congo, Tanzania and Uganda. Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences. Sciences. [www.nmbu.no/download/file/fid/23099](http://www.nmbu.no/download/file/fid/23099).
- Vatn, A., Kajembe, G., Mosi, E., Nantongo, M., 2017. What does it take to institute REDD+? An analysis of the Kilosa REDD+ pilot, Tanzania. *Forest Policy Econ.* 83, 1–9.
- Vega, D.C., Keenan, R.J., 2014. Transaction cost theory of the firm and community forestry enterprises. *Forest Policy Econ.* 42, 1–7.
- Vega, D.E.C., Keenan, R.J., 2016. Situating community forestry enterprises within New Institutional Economic theory: what are the implications for their organization? *J. For. Econ.* 25, 1–13.
- Viana, V., 2010. Sustainable Development in Practice: Lessons Learned from Amazonas. International Institute for Environment and Development. (IIED), London. <http://pubs.iied.org/pdfs/17508IIED.pdf>.
- Wallis, J.J., North, D., 1986. Measuring the transaction sector in the American economy, 1870–1970. In: *Long-Term Factors in American Economic Growth*. University of Chicago Press, pp. 95–162.
- Wang, N., 2003. Measuring Transaction Costs: An Incomplete Survey. Working Paper, 2 Ronald Coase Institute.
- White, D., Minang, P., 2011. Estimating the Opportunity Costs of REDD+: A Training Manual. World Bank Institute, Washington, D.C., USA.
- Williamson, O.E., 1981. The economics of organization: the transaction cost approach. *Am. J. Sociol.* 548–577.
- Williamson, O.E., 1985. *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*. Free Press, New York.
- Williamson, O.E., 2000. The new institutional economics: taking stock, looking ahead. *J. Econ. Lit.* 595–613.